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Effect of Trunk Injection of the Growth Regulators EL-500 and PP 333 on Sprout Growth And The Increase in Height of Trimmed Silver Maple Trees

Report No 86-362-K

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ABSTRACT

A study was initiated in the spring of 1985 on the effect of trunk injection of the growth regulators EL-500 and PP 333 on the growth of sprouts and increase in height of trimmed silver maple trees growing at Wesleyville GS. Both application rates of the growth regulators were found to significantly inhibit the growth of terminal sprouts in single-stemmed trees during the 1986 season. A high application rate of PP 333 also significantly reduced the growth in height of silver maple trees (a mixture of both single- and multi-stemmed) during the same season. Further measurements are to be made in 1987.

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EXECUTIVE SUMMARY

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The control of tree growth under both transmission and distribution lines is a major expense for all electric utilities. Mechanical trimming of trees under distribution lines on city streets and in rural areas is routinely carried out by Ontario Hydro at intervals of four to eight years depending on location. The extension of such trimming cycles by one or more years would result in a substantial cost saving.

A study was initiated in the spring of 1985 on the effect of trunk injection of the growth regulators EL-500 and PP 333 on the growth of sprouts and increase in height of trimmed silver maple trees growing at Wesleyville GS. Data collected in 1985 demonstrated that high and low application rates (20 g/L and 4 g/L) of both EL-500 and PP 333 significantly reduced the growth of terminal sprouts in the single and multi-stemmed silver maple trees examined. The present report describes data collected in the fall of 1986. The high application rate of PP 333 was found to significantly reduce the growth in height of the silver maple trees in the 1986 growing season. Both application rates of EL-500 and PP 333 were found to significantly inhibit the growth of terminal sprouts in single-stemmed trees in 1986 (terminal sprouts on multi-stemmed trees were not measured). Given the inhibition of growth observed with the two growth regulators in 1985 and 1986, it will be of some interest to determine their effects in the 1987 and 1988 growing seasons.

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To: Dr. D. Mills
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1.0 INTRODUCTION

The control of tree growth under both transmission and distribution lines is a major expense for all electric utilities. Mechanical trimming of trees under distribution lines on city streets and in rural areas is routinely carried out by Ontario Hydro at intervals of six to eight years in most locations, and every four years at a few specific locations. The length of the particular trimming cycle depends on the rate of growth of the tree species involved and the amount of line clearance required (Gardner, 1971; EPRI, 1979). The extension of such trimming cycles by one or more years would result in a substantial cost saving (Gardner, 1971).

In the past five or six years a new group of growth regulators has been introduced which is effective in reducing the growth of trees without producing noticeable injury symptoms. In this group are MBR 18337 {N-[4-(ethylthio)-2-(trifluoromethyl) phenyl]-methane-sulfonamide}, PP 333 {(2RS, 3RS)-1-(4-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol-1-yl)pentan-3-ol}, EL-500 {α-(1-methylethyl)-α-[4-(trifluromethoxy)phenyl]-5-pyrimidine-methanol}, and XE 1019 {(E)-p-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol)-1-penten-3-ol}. Both EL-500 and PP 333 have been reported to control excessive sprout growth in a number of species when applied either as a foliar spray or as a soil drench (Hare, 1984; Stinchcombe et al., 1984; Webster and Quinlan, 1984; Aron et al., 1985). While trunk injection of growth regulators offer obvious advantages over other application methods such as avoidance of drift, more precise

application rate control, and the exposure of the applicator to the chemical is limited (Domir, 1978; Roberts et al., 1979), there have been few reports of the effects of trunk injection of EL-500 and PP 333 on sprout growth in trees. Results from short-term studies with both chemicals indicated that sprout growth was reduced (Sterrett, 1985; Arron, 1985, 1986a, 1986b).

In the present report, the effects of trunk injection of EL-500 and PP 333 on sprout growth and the growth in overall height of silver maple (Acer saccharinum) trees are presented. The trees were trimmed and injected with the chemicals in May of 1985 when they were 12 years old.

2.0 MATERIALS AND METHODS

Most of the experimental details have been presented previously (Arron, 1986a). The height of all the trees was recorded in October 1986, with the height in 1985 being determined from the bud scales on the sprouts. Within each treatment group, ie control, methanol control, PP 333 20 g/L, PP 333 4 g/L, EL-500 20 g/L, EL-500 4 g/L, seven single-stemmed and ten multi-stemmed trees were included. In measurements of sprout growth made in October 1986 only the length of sprouts 3 cm or longer was recorded. Shorter sprouts were ascribed a length of zero cm. Only terminal sprouts on single-stemmed trees were measured.

3.0 STATISTICAL TREATMENT

The increase in height of all the trees in the treatment and control groups and the length of terminal sprouts on single-stemmed trees are presented in the form of frequency histograms. For exploratory descriptive data analysis the notch-and-whisker plot procedure in STSC STATGRAPHICS was used. This procedure is a modification of the box-and-whisker plot (McGill et al; 1978). A notch added to the box corresponds to the width of a 95 percent confidence interval for the median, and this allows pairwise comparisons at the 95 percent level by examining whether two notches overlap.

Cumulative relative distribution frequency curves for terminal sprout length were compared statistically in a Kolmogorov-Smirnov two-sample test.

A Kruskal-Wallis one-way analysis of variance procedure was conducted with both the increase in height data from all the silver maple trees and with the terminal sprout length data.

4.0 RESULTS AND DISCUSSION

4.1 Effect of Trunk Injection of EL-500 and PP 333 on the Increase in Height of Silver Maple Trees from 1985 to 1986

As in earlier studies where growth regulators were injected into the trunks of mature trees on city streets (EPRI, 1982) or into tree seedlings grown in the greenhouses (Arron, 1985) it was found useful to order both the sprout lengths and the increases in overall height of the silver maple trees into various classes. Such a frequency distribution for increases in height of all seventeen trees in each treatment or control group is given in Figure 1. All the control trees grew in height by between 0.4 and 1.8 m, while trees in the methanol control group exhibited a more varied response, with six of the seventeen trees either growing less than 0.4 m or more than 1.8 m. Treatment with the high application rate of PP 333 resulted in an abrupt shift in frequency distribution, with ten of the trees in the group growing less than 0.2 m while the remaining trees exhibited little or no inhibition of growth. Such a marked response was not seen with the low application rate of PP 333. The two frequency histograms for the high and low application rates of EL-500 are quite similar. In each case a group of trees (six and five respectively) exhibited poor growth while the remaining trees in each group increased in height from 0.4 m to 2.0 m.

The histograms presented in Figure 1 do not show the extremely small increases in height recorded for some of the trees injected with EL-500 and PP 333. In the group injected with 20 g/L pp 333, seven trees recorded increases in height of 4 cm or less, while in the group injected with 20 g/L EL-500 five trees grew by 4 cm or less. Other trees in these two groups showed a wide range of increases in height (data not shown). The lack of a uniform response within each treatment group was also reflected by the fact that although the mean values for the increases in height of the trees in the control and treatment groups ranged from 50 to 131 cm (PP 333 20 g/L and control respectively), the standard deviations associated with the mean values were extremely large (data not shown). Comparison of the mean values using a statistical test was therefore inappropriate.

The differences between the median increase in tree height for the high application rate of PP 333 and the medians for both control groups and the remaining treatments were statistically significant at the $p=0.05$ level (Figure 2). The medians for the

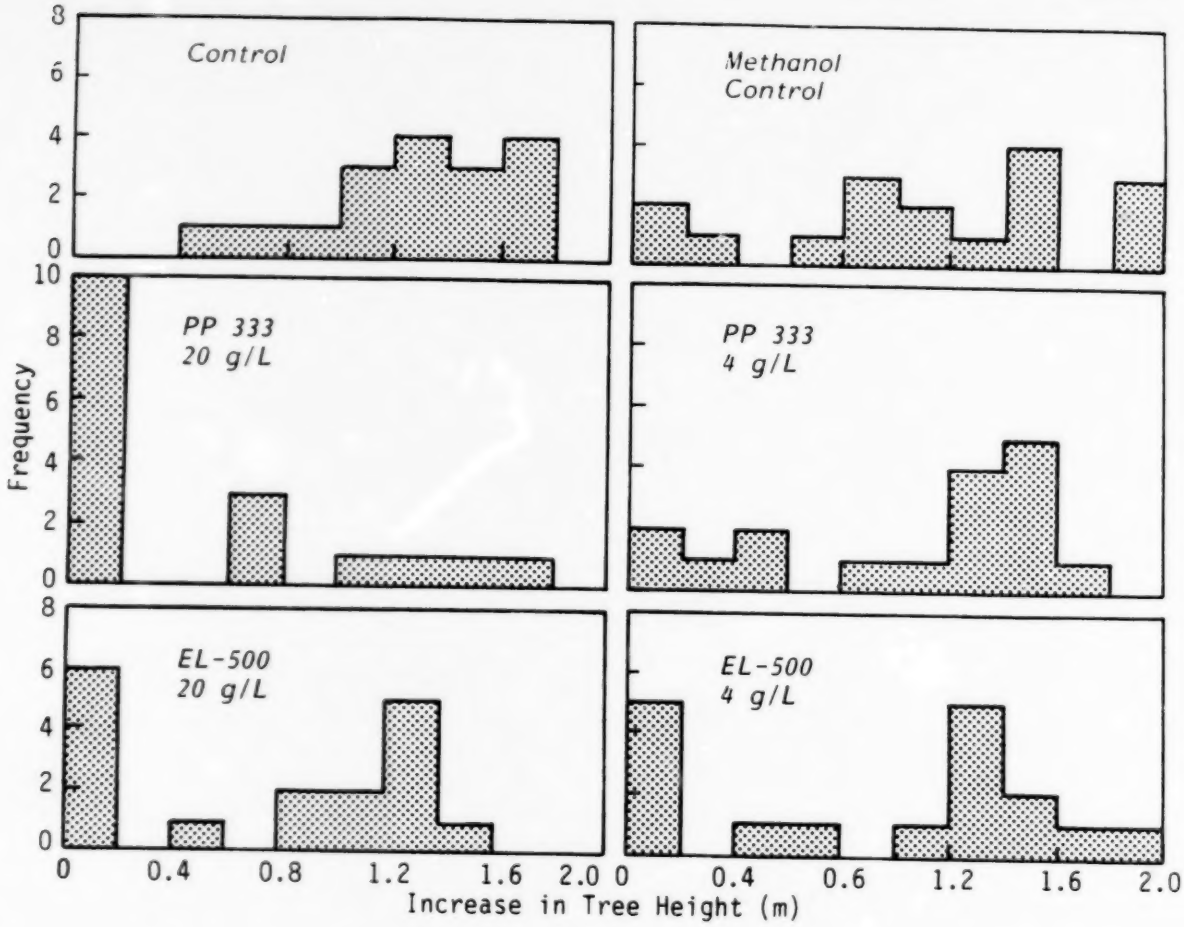

FIGURE 1

EFFECT OF TRUNK INJECTION OF EL-500 AND PP 333 ON THE GROWTH IN HEIGHT FROM 1985 TO 1986 OF SILVER MAPLE TREES AT WESLEYVILLE GS

Seventeen trees (seven single-stemmed and ten multi-stemmed) were included in each control and experimental group. The measured increases in height were grouped into various classes, classes were multiples of 0.2 m, the first class was 0 to 0.2 m, etc.

increase in height of the remaining three treatments were not significantly different from the medians of the two control groups.

An analysis of variance indicated that the increase in tree height of the silver maple trees differed significantly among the control and treatment groups. From the data presented in Figure 2, it would appear that the high application rate of PP 333 resulted in significantly smaller growth. There have been no previous reports on the effect of trunk injection of EL-500 and PP 333 on the growth in height of woody species.

4.2 Effect of Trunk Injection of EL-500 and PP 333 on the Length of Terminal Sprouts Formed on Single-Stemmed Silver Maple Trees in 1986

A frequency distribution histogram showing the effect of EL-500 and PP 333 on the length of terminal sprouts formed in 1986 on single-stemmed trees at Wesleyville GS is given in Figure 3. In all control and treatment groups the largest number of sprouts occur in the 0 to 5 cm length class. The percentage frequency distribution (see right axis) allows the various control and treatment groups to be compared even though there were different numbers of sprouts in each group. While the control and methanol control groups have between 40 and 50% of the sprouts measured in the smallest length class, the high application rates of PP 333 and EL-500 have approximately 85 and 75% respectively in this class. The low application rates of PP 333 and EL-500 have approximately 65 and 75% in the smallest length class.

Comparison of the various control and treatment groups is easier if the data in Figure 3 are replotted in a cumulative fashion, taking the (relative) percentage frequency values and expressing the total as 1.0 and not 100%. The effects of the various treatments are now more obvious (see Figure 4). The bottom two lines represent the control and methanol control groups and these follow much the same path. The high application rate of PP 333 (open triangles) follows a radically different path, with the first point, corresponding to the 0 to 5 cm length class, being located much closer to the top of the vertical axis. The remaining three treatments are located between the curves representing the high application rate of PP 333 and the two control groups.

Such cumulative relative distribution frequency curves were compared statistically in a Kolmogorov-Smirnov two-sample test.

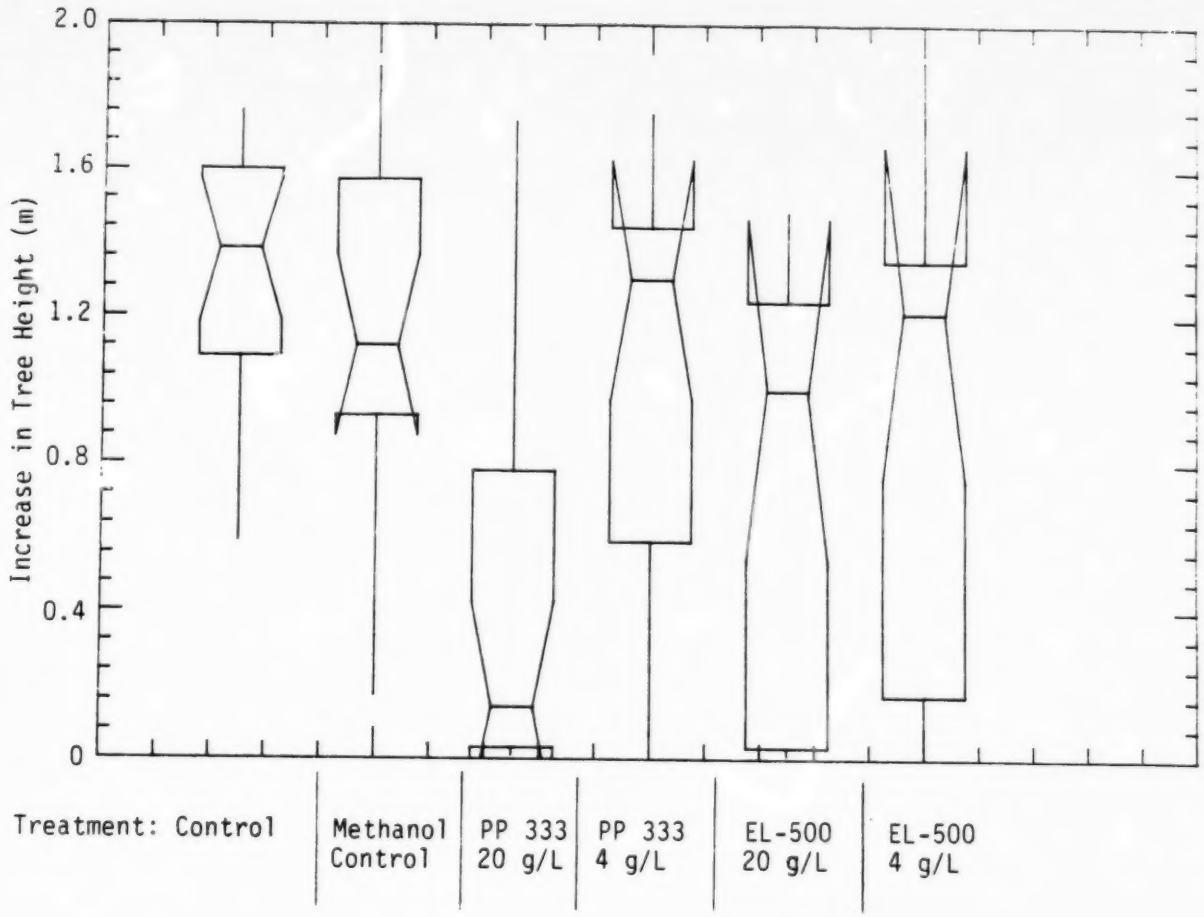

FIGURE 2

EFFECT OF TRUNK INJECTION OF EL-500 AND PP 333 ON THE INCREASE IN HEIGHT FROM 1985 TO 1986 OF SILVER MAPLE TREES AS WESLEYVILLE GS

Confidence level on the notches is set to allow pairwise comparisons to be performed at the 95% level by examining whether two notches overlap. Situations where the notch extends beyond a quartile show a folding in behaviour and little confidence should be placed in these boxes.

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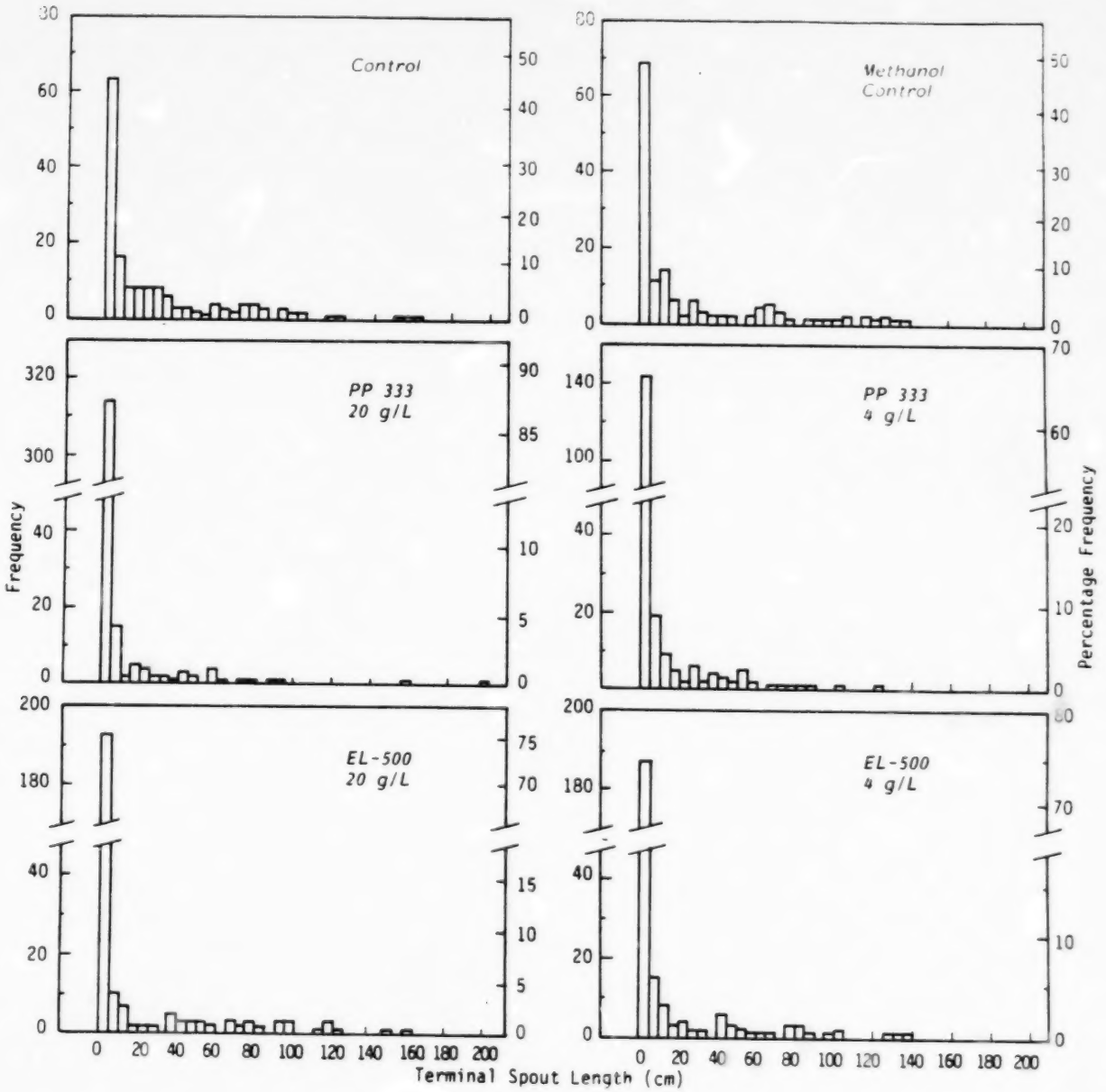

FIGURE 3

HISTOGRAM SHOWING THE EFFECT OF TRUNK INJECTION OF EL-500 AND PP 333 ON THE LENGTH OF TERMINAL SPROUTS FORMED IN 1986 ON SINGLE-STEMMED SILVER MAPLE TREES AT WESLEYVILLE GS

Sprouts were grouped according to length into classes, each class length was 5 cm, classes were 0 to 5 cm etc.

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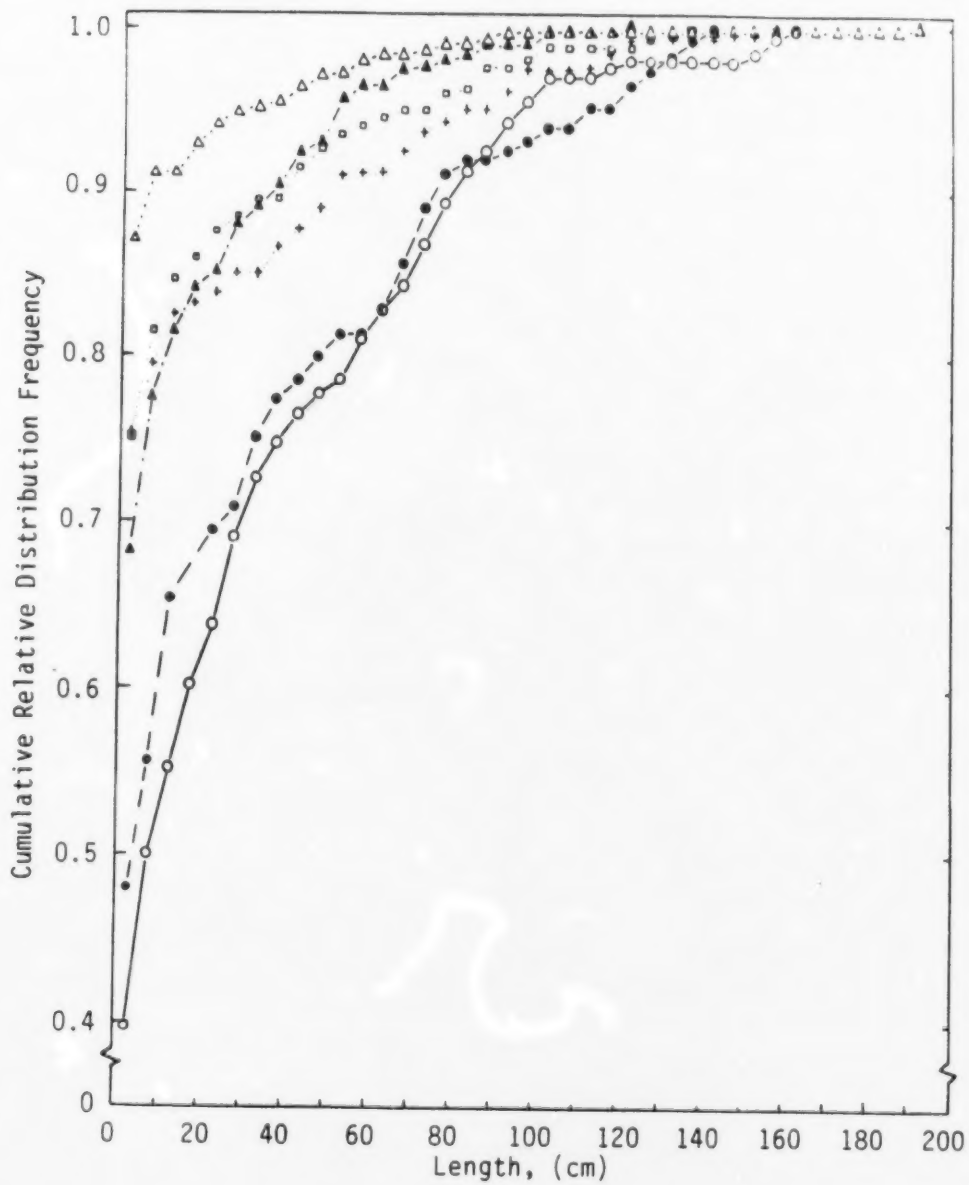

FIGURE 4

CUMULATIVE RELATIVE DISTRIBUTION FREQUENCY SHOWING THE EFFECT OF EL-500 AND PP 333 ON THE LENGTH OF TERMINAL SPROUTS FORMED IN 1986 ON SINGLE-STEMMED SILVER MAPLE TREES AT WESLEYVILLE GS

The frequency data for the length classes (0 to 5 cm etc, see Figure 3) of the terminal sprouts were replotted as a cumulative relative distribution frequency to take into account the different number of sprouts in each treatment.

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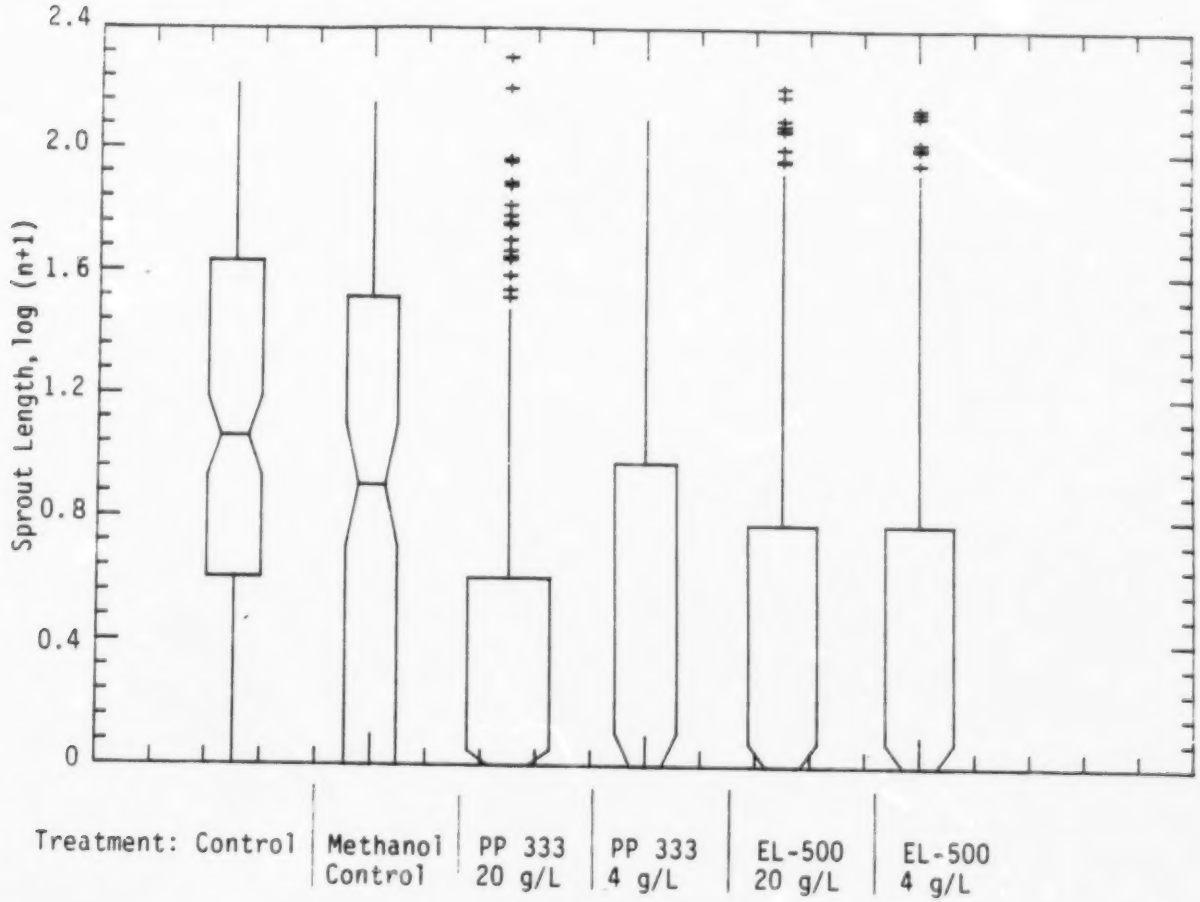

FIGURE 5

EFFECT OF TRUNK INJECTION OF EL-500 AND PP 333 ON THE LENGTH OF TERMINAL SPROUTS FORMED IN 1986 ON SINGLE-STEMMED SILVER MAPLE TREES AT WESLEYVILLE GS

Transformed data, log (n+1), were used in the above analysis. Details on the notch-and-whisker plot procedure are given in Figure 2.

In all cases each curve was significantly different (at the p=0.05 level) from every other curve shown in Figure 4. This suggests that all four treatments resulted in a different relative distribution of short, medium and long terminal sprouts than in the control and the methanol control groups. The significant difference between the control and methanol control curves would suggest that methanol injection had a small effect on the distribution of sprouts by length. There have been no previous reports on the effects of the growth regulators EL-500 and PP 333, or the carrier methanol, on the relative distribution of terminal sprouts by length in a woody species.

The effects of the growth regulators EL-500 and PP 333 on the length of the terminal sprouts formed in single-stemmed trees in 1986 were compared statistically using the notch-and-whisker plot procedure employed previously with the increase in height data. Such an analysis on transformed data (log[n+1]) is shown in Figure 5. Both application rates of PP 333 and EL-500 resulted in shorter terminal sprouts than in the control and methanol control groups, in that there were statistically significant differences in the median sprout length for the four treatment groups and the two control groups. An analysis of variance performed on these data indicated that terminal sprout length differed significantly among the control and treatment groups (at the p=0.01 level).

From the data collected in 1985 from the silver maple trees described above, it was found that all four growth regulator treatments significantly reduced the growth of terminal sprouts on both single- and multi-stemmed trees (Arron, 1986a). The data collected in 1986 indicate that both application rates of EL-500 and PP 333 remained effective in significantly inhibiting the growth of terminal sprouts in single-stemmed trees (multi-stemmed trees were not measured in 1986). In the only published long-term study on the effects of trunk injection of PP 333 Greene (1986) reported that terminal growth in apples was reduced in the year of application and in the two subsequent years. Webster and Quinlan (1984) had previously reported that PP 333 was more inhibitory in the year following the year of application than in the year of application itself. Given these results, the long-term effects of EL-500 and PP 333 in the present silver maple study should prove interesting.

CONCLUSIONS

1. The high application rate of PP 333 (20 g/L) significantly reduced the growth in height of trimmed silver maple trees (both single-and multi-stemmed) in the 1986 growing season.

2. The high and low (4 g/L) application rates of both EL-500 and PP 333 significantly reduced the growth of terminal sprouts on single-stemmed trees during the 1986 growing season.

3. The data described above, and that collected in 1985, demonstrate that the growth regulators EL-500 and PP 333 significantly inhibited sprout growth in the year of application and in the year following application.

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